PART I - ADMINISTRATIVE

Section 1. General administrative information

Title of project

Monitor Symptoms Of Gas Bubble Trauma In Adult Salmonids

BPA project number: 20143
Contract renewal date (mm/yyyy): ☐ **Multiple actions?**

Business name of agency, institution or organization requesting funding
Columbia River Inter-Tribal Fish Commission

Business acronym (if appropriate) CRITFC

Proposal contact person or principal investigator:

Name	Tom Backman
Mailing Address	729 NE Oregon, suite 200
City, ST Zip	97232
Phone	503-238-0667
Fax	503-235-4228
Email address	bact@critfc.org

NPPC Program Measure Number(s) which this project addresses
5.6E.1

FWS/NMFS Biological Opinion Number(s) which this project addresses
IV.A.2.d, NMFS Biological Opinion -Endangered Species Act - Section 7 Consultation

Other planning document references
5B-29 Volume 1 of Wy-Kan-Ush-Mi Wa-Kish-Wit, CBFWA Total Dissolved Gas Supersaturation Research Plan, ISAB Report 98-8, DGT Dissolved Gas Research Plan

Short description
Monitor the frequency and severity of gas bubble trauma symptoms in adult salmonids migrating in the mainstem Columbia River.

Target species
Oncorhynchus mykiss
Oncorhynchus nerka
Oncorhynchus tshawytscha

Section 2. Sorting and evaluation

Subbasin
Columbia River mainstem

Evaluation Process Sort

CBFWA caucus	Special evaluation process	ISRP project type
Mark one or more caucus	If your project fits either of these processes, mark one or both	Mark one or more categories
☒ Anadromous fish ☐ Resident fish ☐ Wildlife	☒ Multi-year (milestone-based evaluation) ☐ Watershed project evaluation	☐ Watershed councils/model watersheds ☐ Information dissemination ☐ Operation & maintenance ☐ New construction ☒ Research & monitoring ☐ Implementation & management ☐ Wildlife habitat acquisitions

Section 3. Relationships to other Bonneville projects

Umbrella / sub-proposal relationships. List umbrella project first.

Project #	Project title/description

Other dependent or critically-related projects

Project #	Project title/description	Nature of relationship
8401400	Smolt Monitoring at Federal Dams	Project 8401400 proposes to examine juvenile fish while we propose to examine adult fish for GBT - in conjunction, the two projects complete mainstem salmonid life cycle examinations

Section 4. Objectives, tasks and schedules

Past accomplishments

Year	Accomplishment	Met biological objectives?

Objectives and tasks

Obj 1,2,3	Objective	Task a,b,c	Task
1	Monitor the frequency and severity of GBT in adult salmonids	a	Conduct sampling at the Bonneville Dam Fisheries and Engineering Research Laboratory
		b	Conduct sampling at Three-Mile Dam

			(Umatilla River)
		c	Conduct sampling at tribal ceremonial and subsistence sites
		d	Analyze results for weekly and annual reports

Objective schedules and costs

Obj #	Start date mm/yyyy	End date mm/yyyy	Measureable biological objective(s)	Milestone	FY2000 Cost %
1	2/2000	10/2000	Data on the incidence and severity of GBT in adult salmonids	Provide data to water quality agencies that issue TDGS waiver - Waiver is reviewed and granted on an annual basis.	100.00%
				Total	100.00%

Schedule constraints
Project depends on Total Dissolved Gas Supersaturation Waivers.

Completion date
On-going monitoring

Section 5. Budget

FY99 project budget (BPA obligated):

FY2000 budget by line item

Item	Note	% of total	FY2000
Personnel		%53	59,560
Fringe benefits		%10	11,447
Supplies, materials, non-expendable property		%1	1,410
Operations & maintenance		%4	4,470
Capital acquisitions or improvements (e.g. land, buildings, major equip.)		%0	
NEPA costs		%0	
Construction-related support		%0	
PIT tags	# of tags:	%0	
Travel		%4	4,938
Indirect costs		%27	30,930
Subcontractor		%0	
Other		%0	

TOTAL BPA FY2000 BUDGET REQUEST	$112,755

Cost sharing

Organization	Item or service provided	% total project cost (incl. BPA)	Amount ($)
		%0	
		%0	
		%0	
		%0	
		Total project cost (including BPA portion)	$112,755

Outyear costs

	FY2001	FY02	FY03	FY04
Total budget	118,393	124,312	130,527	137,053

Section 6. References

Watershed?	Reference
☐	Backman W.H., A.F. Evans, and M.A. Hawbecker. 1998. Symptoms of Gas Bubble Trauma induced in salmon (Oncorhynchus spp.) by total dissolved gas supersaturation of the Snake and Columbia Rivers, USA. 1997 Annual Report. 95BI39861, BPA. Portland, OR.
☐	Beiningen, K.T., and W.J. Ebel. 1970. Effect of John Day Dam on dissolved nitrogen concentrations and salmon in the Columbia River, 1968. Transactions of the American Fisheries Society. 99 (4): 664-671.
☐	Blahm, T.H., R.J. McConnell, and G.R. Synder. 1976. Gas supersaturation research, National Marine Fisheries Service, Prescott Facility - 1971-1974. Proceedings of Gas Bubble Disease Workshop. U.S. Department of Commerce, Technology Information Service
☐	CBFWA (Columbia Bsin Fish and Wildlife Authority). 1998. Total Dissolved Gas Supersaturation Research Plan. CBFWA, Portland, OR.
☐	CRITFC (Columbia River Inter-Tribal Fish Commission). 1995. Wy-Kan-Ush-Mi Wa-Kish-Wit: The Columbia River anadromous fish restoration plan of the Nez Perce, Umatilla, Warm Springs, and Yakama tribes. CRITFC, Portland, OR.
☐	Dawley, E.M. 1986. Effects of 1985-86 levels of dissolved gas on salmonids in the Columbia River. Report to U.S. Army Corps of Engineers, Contract DACW-57-85F-0623, 31p. (Available from Northwest Fisheries Science Center, 2725 Montlake Blvd. E., Seattle,
☐	Dell, M.B., M.W. Erho, and B.D. Leman. 1974. Occurrence of gas bubble disease symptoms on fish in mid-Columbia River reservoirs, 49 p. (Available from Public Utility District of Grant County, P.O. Box 878, Ephrata, WA 98823.)
☐	DGT (Dissolved Gas Team). 1998. Dissolved Gas Research Plan. Report to the Implementation Team as requested by the Independent Scientific Advisory Board. Available from National Marine Fisheries Service. Seattle, Washington.
☐	Ebel, W.J. 1969. Supersaturation of nitrogen concentrations in the Columbia and its effects on salmon and steelhead trout. U.S. Fish Wildlife Service, Fishery Bulletin. 68:1-11.
☐	Ebel, W.J. 1971. Dissolved nitrogen concentrations in the Columbia and Snake Rivers in 1970 and their effect on chinook salmon and steelhead trout. NOAA Tech. Rep. National Marine Fisheries Service, SSRF-646, 7p.
☐	Ebel, W.J., H.L. Raymond, G.E. Monan, W.E. Farr, and G. K. Tononaka. 1975. Effects of atmospheric gas supersaturation caused by dams on salmon and steelhead trout of the Snake and Columbia Rivers. 111 p. (Available from Northwest Fisheries Science Center,

☐	Ebel W.J. and H.L. Raymond. 1976. Effect of atmospheric gas supersaturation on salmon and steelhead trout of the Snake and Columbia Rivers. Marine Fisheries Review. 38(7):1-14.
☐	
☐	ISAB (Independent Scientific Advisory Board). 1998. Review of the U.S. Army Corps of Engineers' Capital Construction Program. Part II: Dissolved Gas Abatement Program. ISAB Report 98-8 for the NPPC and NMFS. Seattle, Washington.
☐	Lutz, Donna S. 1995. Gas supersaturation and Gas Bubble Trauma in Fish Downstream from a Midwestern Reservoir. Transactions of the American Fisheries Society. 124: 423-436.
☐	Marking, L.L. 1988. Gas supersaturation in Fisheries: Causes, Concerns, and Cures. U.S. FishAnd Wildlife Service, Fish and Wildlife Leaflet 9, p. 16.
☐	Meekin, T. K., and R. L. Allen 1974. Nitrogen saturation levels in the mid-Columbia River, 1965-1971. Washington Department of Fisheries.,Technical Report. 12, p. 32-77.
☐	Meekin, T.K., and B.K. Turner. 1974. Tolerance of salmonid eggs, juveniles and squawfish to supersaturated nitrogen. Washington Department of Fisheries., Technical Report. 12, p. 78-126
☐	NMFS (National Marine Fisheries Service). 1995. Endangered Species Act – Section 7 Consultation. Biological Opinion. NOAA National Marine Fisheries Service, Northwest Region, Seattle, Washington.
☐	NPPC (Northwest Power Planning Council). 1995. 1994 Columbia River Fish and Wildlife Program (revised 1995). Portland, Oregon.
☐	Snedecor, G.W. and W.G. Cochran, 1980. Statistical Methods (7th edition). Iowa State University Press. Ames, IA.
☐	Weitkamp, D. E. 1974. Snake River 1973, dissolved gas studies. Report to Idaho Power Company, Boise, ID, 81 p. (Available from Idaho Power Co., P.O. Box 70, Boise, ID 83707.)
☐	Weitkamp, D.E. 1976. Dissolved gas supersaturation: live cage bioassays at Rock Island Dam, Washington. Proceedings of Gas Bubble Disease Workshop. U.S. Department of Commerce,Technology Information Service. CONF-741033, p. 24-36.
☐	Weitkamp, D.E. and M. Katz. 1975. Resource and literature review, dissolved gas supersaturation and gas bubble disease, 1975. Environmental. Services. Section, 4122 Stone Way N. Seattle, WA, Report to Northwest Utility Cooperative. (Idaho Power)
☐	Weitkamp, D.E. 1977. Gas Bubble Disease of Resident Fish and Juvenile Salmonids in the Columbia River System. Ph.D. Dissertation for the University of Washington,Seattle, WA.

PART II - NARRATIVE

Section 7. Abstract

Columbia River salmon restoration plans have recommended the implementation of a spill program at the federal hydroelectric projects designed to achieve an >80% fish passage efficiency (FPE) objective. To accomplish this goal, total dissolved gas supersaturation (TDGS) levels often exceed the established state and federal water quality criteria. Prolonged exposure of fish to TDGS can cause a potentially lethal condition referred to as gas bubble trauma (GBT). To address this concern, an annual GBT monitoring effort has been initiated for juvenile fish. At the same time juvenile fish are migrating towards the ocean, adult chinook (*Oncorhynchus tshawytscha)* sockeye (*O. nerka*), and steelhead (*O.mykiss)* are migrating past dams to their spawning grounds. Supersaturation levels, therefore, are a concern for adult salmon as well as juvenile salmon. Thus, an annual GBT monitoring program is needed for adult salmonids in the Columbia River to ensure that the benefits of managed spill, for improved juvenile FPE, are not having a negative impact on adult migrants. Based on methods developed and reviewed in a prior research/monitoring effort, we propose to continue examining adult salmonids for symptoms of GBT at Bonneville Dam, Three-Mile Dam and at various tribal plat-form fishing sites throughout the Columbia River. We propose to continue monitoring adult salmonids for GBT symptoms as long as it is required and/or needed by water quality agencies. Such monitoring will provide consistent, real-time information

on the incidence and severity of GBT in adult salmonids and can be used to assess the biological impact of spill in the mainstem Columbia River.

Section 8. Project description

a. Technical and/or scientific background

The NMFS Biological Opinion (NMFS 1995), the NPPC Fish and Wildlife Program (NPPC 1995), and the Tribal Restoration Plan (CRITFC 1995) have recommended the implementation of a spill program at the federal hydroelectric projects designed to achieve an >80% fish passage efficiency (FPE) objective. Spilling water is not without costs. As noted in the NMFS Biological Opinion in section IV.A.2.d (NMFS 1995) dissolved gas levels increase during spill as water passes over the spillway and plunges to the tailrace. As a result total dissolved gas saturation (TDGS) levels, which can rise to over 130%, often exceed the Environmental Protection Agency, Washington State Department of Ecology, and Oregon State Department of Environmental Quality maximum standard of 110% supersaturation. Supersaturation above 130% is deleterious to resident fish (Dell et al. 1974; Weitkamp 1974), caged juvenile salmon (Ebel 1969; Ebel 1971; Meekin and Turner 1974; Weitkamp 1976; Blahm et al. 1976; Dawley 1986), migrating adult salmon (Beiningen and Ebel 1970; Ebel 1971; Meekin and Allen 1974; Ebel et al. 1975; Ebel and Raymond 1976), and fish held in the laboratory (Weitkamp and Katz 1975).

Fish affected by elevated supersaturation levels may exhibit external gas bubble trauma (GBT) symptoms that are identifiable by physical examination. These symptoms are exhibited as bubbles or emboli and occur at a variety of locations on a fish. These locations include the fins, eyes, operculum, lateral line, mouth, head, gills, and internal organs. The easiest and most commonly seen signs are bubbles within the lateral line and the fin rays of the fish. The size and location of these bubbles is dependent on the severity of the trauma and species of fish (Weitkamp 1977). The direct cause of death due to symptoms has generally been attributed to blood stasis resulting in anoxia (Weitkamp 1977).

Results from laboratory studies on juvenile fish suggest that external gas bubble trauma symptoms become more pronounced, and potentially more detrimental, as the duration and/or level of exposure increases (Mesa et al. –in press). In this fashion, the onset of GBT is progressive and signs can be detected before mortality. Despite this relation, linking physical signs of GBT to mortality has proven difficult because symptom severity and time to death varies largely from one individual to the next (Mesa, CRRL, pers. com.). Such variation makes it difficult to quantify a particular symptom rank (proportion of fin or later line occluded by bubbles) with a precise estimate of population mortality. Fortunately, the incidence of GBT is postitively correlated with %TDGS (Backman et al. 1998) and therefore river management decisions can be made regarding the effects of spill on adult migrants if signs are monitored. It's important to note that the degree and effects of exposure to elevated concentrations of dissolved gas may change when a fish changes depth (Lutz 1995). Because effective supersaturation decreases approximately 10% for each meter of depth (Weitkamp 1977), fish can elude supersaturated water if compensation depth is available (Lutz 1995**).** Only in-river monitoring can adequately assess GBT because laboratory conditions can not simulate the complex exposure history that adults receive.

In the 1960's and 1970's fisheries biologist's noticed a substantial number of adult salmonids showing classic signs of gas bubble trauma (GBT) in sections of the Columbia and Snake River (Ebel, J 1969; Beiningen, K.T and Ebel, J 1970; Weikamp and Katz 1975). Despite these early observations, the primary focus of GBT research and monitoring conducted to date has centered on juvenile salmonids. This includes an on-going smolt monitoring program conducted by the Fish Passage Center, which has compiled a large database of information relating to juvenile salmonids and the incidence of GBT. The amount of GBT data

pertaining to adult salmonids is relatively limited (DGT 1998; ISAB 1998), especially given the early documentation of the problem. In an attempt to gather adult GBT data, a monitoring program was initiated in 1995 by biologist working for the Columbia River Inter-Tribal Fish Commission (CRITFC).

CRITFC has actively examined both juvenile and adult salmonids in the Columbia River under BPA funded project 9300802 (Backman et al. 1998). CRITFC biologists collected data on the prevalence and incidence of GBT in adult salmon at the Fisheries Engineering Research Laboratory at Bonneville Dam and at various tribal fishery sites located below John Day and The Dalles dams. Data collected in 1997 indicated that when TDGS levels exceed 130% all monitored adult species were effected by GBT (Backman et al.1998) of varying severity and incidence. However, during periods of controlled spill, when TDGS levels often remain below 120%, the incidence and severity of GBT in adults appears to be minor with < 2% of all observed fish with symptoms of GBT. Despite the completion of research tasks (for juvenile fish) in project 9300802 (expected in 1999), we feel the adult **monitoring** aspect of the project should continue beyond next year. The adult monitoring tasks for the proposed project have been peer reviewed by the NMFS expert panel, ISAB, ISRP, and the CBFWA in prior years.

Section 5.6E.1. of the Columbia River Basin Fish and Wildlife Program request that studies focus on the relationship between "supersaturation and its effects on salmon and steelhead passing ..adult ladders, reservoirs and other mechanisms" (NPPC 1995). More recently, the Independent Scientific Advisory Board, the Dissolved Gas Team and the Columbia Basin Fish and Wildlife Authority have recognized the need for adult GBT monitoring (CBFWA 1998; DGT 1998; ISAB 1998). Specifically, the Dissolved Gas Team stated that the "monitoring (of) adults for symptoms of GBT needs to be continued" (DGT, page 15, 1998).

In FY00 we propose to continue monitoring the incidence and severity of GBT in adult salmonids migrating in the Columbia River. Information obtained from this proposed monitoring program would provide fishery managers and hydropower system operator's real time information on the prevalence of GBT in adult salmonids. Monitoring of adults will help ensure that waivers to the TDGS standard, issued by the water quality agencies, are not having a negative affect on migrating adults. In prior years, such monitoring was required before a waiver could be issued (CBFWA 1998). Furthermore, gas abatement measures being implemented by the U.S. Army Corps of Engineers need to be monitored and evaluated to ensure that the desired effects (e.g., reduction in TDGS and the impact of GBT on salmonids) are being achieved. The ISAB has requested that results from implemented gas abatement measures should "relate its finding to the gas bubble trauma monitoring programs conducted by others" (ISAB, page 2, 1998). From a biological perspective, the monitoring of GBT signs in adult salmon throughout the Columbia River will aid in those evaluations.

b. Rationale and significance to Regional Programs

The NMFS Biological Opinion (NMFS 1995), the Fish and Wildlife Program (NPPC 1995) and the Tribal Restoration Plan (CRITFC 1995) all recommend the implementation of managed spill to achieve and >80% FPE objective. To accomplish this goal TDGS levels must exceed state and federal water quality criteria and may potentially cause a serious condition referred to as gas bubble trauma (GBT). Water quality agencies require that GBT monitoring of both juvenile and adult fish be conducted if a waiver to the TDGS standard is to be granted. The CRITFC is proposing to implement an adult monitoring program, initiated in under project 9300802, that would fulfill the requires of a TDGS waiver. In addition to the water quality agencies need for adult GBT monitoring, section 5.6E.1 of the Columbia River Basin Fish and Wildlife Program request that studies focus on the relationship between "supersaturation and its effects on salmon and steelhead passing…adult ladders, reservoirs, and other mechanisms" (NPPC 1995). The Dissolved Gas Team –formed by the National Marine Fisheries Service, and

the Columbia Basin Fish and Wildlife Authority also recognize the need for continued GBT monitoring in adult salmonids (DGT 1998; CBFWA 1998).

c. Relationships to other projects

U.S. Army Corp of Engineers (USACE)

- TDGS monitoring at hydroelectric facilities. This is important in estimating the levels of TDGS that migrating adult salmonids have been exposed to. TDGS data collected by USACE will be compared to GBT frequency and severity data collected during monitoring.

Fish Passage Center, Portland OR

-The Smolt Monitoring Program (SMP) is the primary tool used in assessing the prevalence of GBT in migrating juvenile salmonids. If coupled with adult GBT monitoring, it will insure that both critical life histories are monitored in the Columbia mainstem.

Columbia River Research Lab, Cook WA

- In FY00 the Columbia River Research Lab is proposing to study the affects of gas bubble trauma on the viability of adult salmonid gametes. In addition, they are proposing to study the depth distribution of adult migrants in the Columbia River. If funded, data collected in an adult monitoring program could be utilized to interpret research result by providing in-river GBT data.

d. Project history (for ongoing projects)

Although this project is being proposed as a new adult monitoring program, the work is a continuation from a prior research project (Symptoms of GBT induced in Salmon by TDGS of the Columbia and Snake Rivers – 9300802). Adult salmonid GBT examination methods and the feasibility of a monitoring program were developed and confirmed during this study. Results from GBT adult monitoring at Bonneville Dam and at C&S plat-form site in 1995, 1996 and 1997 can be viewed in Backman et al. 1998.

e. Proposal objectives

Assumptions:

- Adults sampled at the hydroelectric facilities are representative of in-river adult populations.

- Sufficient sample sizes can be obtained.

- Based on frequency and severity of GBT symptoms, detrimental effects, or lack of, could be assessed and thus influence management decisions about hydropower operations (e.g., spill, transportation).

- GBT monitoring is an annual requirement or an expressed need of state and federal water quality agencies.

Sub-lethal and lethal supersaturation levels are a concern for adult salmon as well as juvenile salmon. To address these concerns, GBT adult monitoring will be conducted at the Fisheries Engineering Research Laboratory at Bonneville Dam. Validation for adults examined at the dam (both Bonneville and Three Mile) is needed to confirm that adult salmonids traveling through hydroelectric facilities are representative of in-river adult populations. Sampling from the tribal fishery (ceremonial and subsistence) will allow for the monitoring of the in-river condition of adults and provide a potential validation method for examinations at hydroelectric facilities. Biological data collected from monitoring, coupled with TDGS levels, will help assess the impact of spill on adult migrants and fulfill the requirement of state issued TDGS waivers.

f. Methods

Sampling Locations: Adult chinook, sockeye, and steelhead will be sampled and examined for signs of gas bubble trauma, at the Fisheries Engineering Research Laboratory at Bonneville Dam (*task 1.a*), 2-3 days per week from April 1 through July 30, 2000. Adult salmonids will be diverted from the north fish ladder (Washington) of powerhouse II at Bonneville Dam, river kilometer (R.K.) 235. Adult spring chinook and steelhead returning to the Umatilla's Three-Mile Dam fish hatchery (*task 1.b.)* will be examined during trap collection. The hatchery's close proximity to the Columbia River make it an important upper mainstem examination site because fish are collect shortly after they exit the Columbia River below the tailrace McNary Dam.

Columbia River adult salmonids harvested during the tribal C&S fishery will also be examined for symptoms of GBT (*task 1.c.).* Three scaffold fishing sites below The Dalles Dam will be sampled at least 5 days a week from April 1 through July 30, 2000: Lone Pine (R.K. 302 to 304), under The Dalles Bridge on the Oregon side of the river (R.K. 302), and along the peninsula extending from the Washington side of the dam (R.K. 302). Platform sites on the Washington and Oregon shore, above Bonneville Dam, will also be utilized. Samples from below John Day Dam will also be collected at platform sites located on the Washington shore.

Examination procedures: Adults examined at Bonneville will be placed in a 380-l sampling tank, filled with fresh river water at the start of each sampling period. Fish will be anesthetized with a buffered Tricane Methane Sulfonate (MS-222) solution and carefully examined for external symptoms using a 2.5X headband binocular magnifier. Held with two hands at the waters surface, a specimen can be easily rotated along the axis of its body. This will permit the inspection of both sides of the body and the mouth cavity. Included in the examination procedure will be an observation of external symptoms such as distended eyes and/or the presence of emboli within the mouth, on the operculum, or between fin rays (Beiningen and Ebel 1970). Particular attention will be paid to the head, the operculum, and the insertion of each fin ray. The degree of affect in each specific region will be ranked 1-4 according to the percent of the area-covered. The degree of severity of external symptoms are classified by the percentage of an area (e.g., a fin) covered with bubbles. A ranking system was developed by Columbia River Research Lab, under the direction of Dr. Alec Maule, to quantify the severity of bubbles. A rank of "1" will account for up to 5% fin occlusion, a rank of "2" for 6% to 25%, a rank of "3" for 26% to 50%, and a rank of "4" for greater than 50% fin occlusion. Percent occlusion of the lateral line will be determined with a bubblemeter. A bubblemeter is a narrow, flexible, transparent plastic strip with a grid of equally spaced, unitless hatchmarks (approx. 0.5 mm per square). The bubblemeter will be placed on the left side of the fish, parallel to the lateral line. The number of total units containing bubbles along the lateral line will be recorded and the total length of the lateral line will be measured in bubble units. A percentage of the lateral line occluded by bubbles will then be determined. The examination procedure is analogous to one currently used by the Smolt Monitoring Program[1]. Based on prior experience, we estimate individual examinations to take approximately 30 s. Following the inspection, fish will be allowed to recover in freshwater and than released.

C&S caught fish will be examined using the same protocol described for sampling at Bonneville Dam except the fish will not be anesthetized since they will be subdued (euthenized) by the fisher. The tribal fishers fish with hoop nets approximately 8-12 feet in diameter with mesh sizes selected for their target species. Some fishers used a sensitivity line and remove fish as soon as they are entangled in the net, but most check their nets every 30 minutes to an hour. Fish that are in the nets for an unknown period of time and are dead upon removal will not be sampled. Research suggests that gas emboli dissipate and external evidence (emphysema) disappears within 24 hours after blood flow stops (Marking 1988). All adult fish sampled during the C&S fishery will be returned to the fisher after examination.

Statistical procedures used in adult analysis:

[1] The Smolt Monitoring Program is implemented by the Fish Passage Center and examines chinook and steelhead smolts captured at the juvenile bypass facilities.

Sample size determination: Sample size is strongly dependent on the number of adult salmonid returning to the Columbia River 2000. Based on the success of prior years, we expect to examine at least 1000 spring/summer chinook, 400 sockeye and 400 steelhead for GBT symptoms. Based on an average from the past two years of Tribal C&S monitoring, in-river samples are expected to contribute at least 300 chinook, 60 sockeye and 60 steelhead. All adults captured for spawning at Three-Mile Dam (Umatilla River) will be examined for GBT. Again, based on previous years, we estimate that at least 1,000 adult salmonids can be examined. In total, we estimate a minimum of 3,200 adult examinations spread throughout the lower to mid-Columbia mainstem.

To estimate the sample size required to determine the percentage of the population with symptoms (assuming a population of infinite size) we followed the procedure developed by John Beeman at CRRL as part of the Smolt Monitoring Program of the Fish Passage Center. This method was derived from Snedecor and Cochran (1980). Simulation suggests a sample of 40 adult fish will provide an estimate of symptom prevalence of ± 9.4% when $P = 0.1$, and ± 15.6 % when $P = 0.5$. Increasing the sample size to n = 100 increases the precision, resulting in confidence intervals of ± 6 and ± 10% respectively. In other words, if we detect a 10% symptom prevalence, at $P=0.1$ and a sample size of $\geq$ 100 fish, we can conclude that between 4% and 16% of the actual in-river population has symptoms. Adult samples collected during the monitoring will be subjected to this analysis and a total in-river symptom estimate generated.

TDGS Measurements: Daily mean percent TDGS measurements from stations below Bonneville, The Dalles, John Day and McNary Dam will be obtained from the USACE dissolved gas summaries. Observations of GBT will be reported as a percentage of the day's sample size, and compared to the 24-hour mean %TDGS measurement for each sampling site.

Compiling, Analyzing and Report Results (*task 1.d.):*
Data will be recorded on field data sheets and entered into a database file. Computer data will be crosschecked with field data to correct and validate. Information relating to location of examination, incidence (as a percentage) and severity (based on rank) of symptoms and TDGS levels (collected by the USACE) will be up-dated every other Friday and made available on the World Wide Web. Observations of GBT at Bonneville Dam, Three-Mile Dam and at in-river platform sites will be reported as a percentage of the week's total adult migration past the nearest dam.

An annual report, which summarizes project results will be submitted to the funding agency and distributed to all interested parties. The annual report will also address any potential monitoring shortcomings or other unexpected difficulties that arise during the monitoring period. Modifications for the next years effort will than be assessed and addressed.

Staff training:
Staff will be trained in symptom examination techniques by the Columbia River Inter-Tribal Fish Commission, Portland, OR under the direction of Dr. Tom Backman. Quality control measures of field procedures will be implemented to insure correct and consistent data collection among biologists. The quality control procedure will consist of a trained biologist examining five fish with a trained QA/QC biologist observing, timing, and recording the biologist's procedure. The trained supervisor will then examine the same five fish to assure that the observations are of consistent quality.

g. Facilities and equipment

This project requires limited equipment for examinations at Bonneville Dam, Umatilla River and C&S sites. Basic examination equipment includes: headband binocular magnifier, MS-222, data sheets, and rain gear for C&S technicians. Transportation will be needed for technicians working at Bonneville and C&S sites. Due to the remoteness of sites, cell phones will be needed for technicians examining C&S captured fish. CRITFC will provide computers and office space.

h. Budget

Since the examination of adults for symptoms of GBT was conducted in prior years by the CRITFC, we simple used past knowledge to calculate both personnel and equipment needs. The bulk of funds (53%) are needed to cover 4 technicians, 1 biologist and a managing scientist. All positions are needed on a part time basis only. The Confederated Tribes of the Umatilla Indian Reservation are providing personnel costs for task 1.b..

Section 9. Key personnel

Dr. Thomas W.H. Backman
PROJECT MANAGER: Senior Fishery Scientist
FTE: 0.1

EDUCATION:

B.Sc. and M.Sc. in Marine Biology, San Diego State University.
Ph.D. in Fisheries, University of Washington.

CURRENT EMPLOYMENT:

Columbia River Inter-Tribal Fish Commission
729 N. E. Oregon, Suite 200
Portland, OR. 97232

Dr. Backman has been a Senior Fishery Scientist with the Commission since 1991. During that time he as served as the President of the Oregon Chapter of the American Fisheries Society, a member of the NMFS Expert Panel of Gas Bubble Trauma, and a member of the NMFS/EPA gas bubble team. Dr. Backman provides scientific expertise on salmon recovery issues by conducting research, developing scientific papers and analyses, participation in workshops, formulating recovery strategies, and providing expert testimony.

Prior to CRITFC, Dr. Backman was a Fishery Biologist (GS-13) with the U.S. Fish and Wildlife Service (FWS). His duties with FWS were: Administrated and participated in technical groups for the U.S. Fish and Wildlife Service under the Emergency Stripped Bass Act. Administrated the Andramous Grants Program. Conducted laboratory and field research on American Shad. Dr. Backman's graduate research (NSF funded) focused on fish habitat related research, including quantitative genetics research and development of habitat restoration technology for depleted and damaged submerged aquatic vegetation.

Backman W.H., A.F. Evans. and M.A. Hawbecker. 1998. Symptoms of Gas Bubble Trauma induced in salmon (Oncorhynchus spp.) by total dissolved gas supersaturation of the Snake and Columbia Rivers, USA. 1998 Annual Report. 95BI39861, Bonneville Power Administration, Portland, OR.

Backman, T.W.H., R. M. Ross and B. Kriss. 1991. Tolerance of sub-yearling American shad to short-term exposure to gas supersaturation. North American Journal of Fisheries Management. 11:67-71.

Ross, R. M. T. W. H. Backman, and R. M. Bennett. 1993. Evaluation of Habitat Suitability Index Models for Riverine Life Stages of American Shad, with Proposed Models for Premigratory Juveniles. U.S. Fish and Wildlife Service Biological Report 14.

Panel 1994a. Panel on Gas Bubble Disease, Report and Recommendations (June 21-22, 1994). (Available from Northwest Fisheries Science Center, 2725 Montlake Blvd.

E., Seattle, WA 98112-2097.)

Allen F. Evans
Project Biologist
FTE:0.5

EDUCATION

B.A., Biology, The College of Wooster, Wooster, Ohio. May 1995.

Rhodes University, Department of Ichthyology, Grahamstown, South Africa. May – August 1994. Attended graduate fisheries classes and conducted research for the fisheries department.

CURRENT EMPLOYMENT:

Columbia River Inter-Tribal Fish Commission
729 N. E. Oregon, Suite 200
Portland, OR. 97232

Allen has 4+ years of experience working with salmon. Allen has been a biologist with the Columbia River Inter-Tribal Fish Commission for three years and has worked on the Gas Bubble Trauma project for each of those years. Prior to working for CRITFC Allen was employed at the U.S.G.S., Biological Resources Division, Seattle, WA and at the Department of Ichthyology, Rhodes University, Grahamstown, South Africa.

Allen will maintain the following responsibilities: Manage database, graphic programs, statistical programs and other computer oriented skills. Serves as field biologist by sampling and examining salmonids for signs of Gas Bubble Trauma. Supervise field technicians. Responsible for the completion of all field research objects. Analyze, synthesize and prepare data for technical reports, publications and seminars. Produce technical papers and give scientific presentations. Maintain scientific sampling permits (ESA etc…) and coordinate research needs with other agencies.

Backman W.H., A.F. Evans. and M.A. Hawbecker. 1998. Symptoms of Gas Bubble Trauma induced in salmon (Oncorhynchus spp.) by total dissolved gas supersaturation of the Snake and Columbia Rivers, USA. 1998 Annual Report. 95BI39861, Bonneville Power Administration, Portland, OR.

Backman W.H., A.F. Evans. and M.A. Hawbecker. 1997. Symptoms of Gas Bubble Trauma induced in salmon (Oncorhynchus spp.) by total dissolved gas supersaturation of the Snake and Columbia Rivers, USA. 1998 Annual Report. 95BI39861, Bonneville Power Administration, Portland, OR.

Davies M.T. and A.F Evans. The possible Significance of Egg Size on Post-hatched Growth of rainbow Trout (*Oncorhynchus mykiss).* Proceedings of the Aquaculture Association of Africa. No. 5. Page (s) 137-143. 1996.

Section 10. Information/technology transfer

Information relating to the location of examination, incidence (as a percentage) and severity (based on rank) of symptoms and TDGS levels (collected by the USACE) will be up-dated every other Friday and made available on the World Wide Web. Data will be reported in the same format used by the Smolt

Monitoring Program. Data will also be made available to the NMFS for reporting to the water quality agencies and in an annual report to Bonneville Power Administration.

Congratulations!